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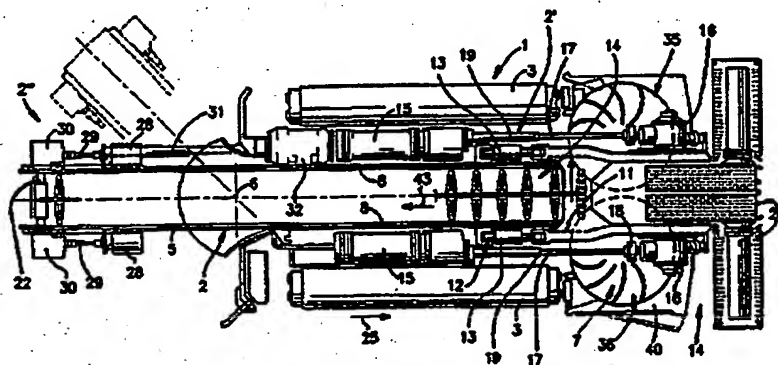
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(71) Applicant: COALTEX, INC. [US/US]; P.O. Box 1085, Beckley, WV 25801 (US).			
(72) Inventor: DELLI-GATTI, Frank, A., Jr.; CoalTex, Inc., P.O. Box 1085, Beckley, WV 25801 (US).			
(74) Agent: VANDERHYE, Robert, A.; Nixon & Vanderhye P.C., 8th floor, 1100 North Glebe Road, Arlington, VA 22201-4714 (US).		Published With international search report.	

(54) Title: MINING ULTRA THIN COAL SEAMS



(57) Abstract

A continuous mining machine (4) is provided for mining ultra thin coal seams (54), e.g. seams having a thickness of about 60 centimeters or less. A chassis (25) supported by crawler tracks (53) has a substantially horizontal axis powered cutter head (14) mounted to its front and a conveyor (4) extending from a gathering head (7) toward the rear of the chassis. The conveyor includes a conveyor chain (9) driven by at least one motor (28) near the rear of the chassis for driving a sprocket. The gathering head includes a pair of counter-rotating discs (35, 36) with upstanding vanes (37) and a deck (40) having a maximum angle of about 10° with respect to the dimension of elongation (25) of the chassis. A small diameter idler sprocket (23) for the conveyor chain is mounted beneath the deck, and a small diameter drive sprocket (21) is provided for the cutting chain of the cutting head. The mining machine is controlled to keep it within a coal seam to be cut by using a first color video camera (60) scanning the ceiling (51) of the bore cut by the miner, and a second color video camera (61) scanning the floor (41). The mining machine may be used in a method of mining in which, after formation of a main bore (42) of about 90-180 meters long, during withdrawal the machine forms a number of angled bores (60) each roughly as long as the length of the machine.

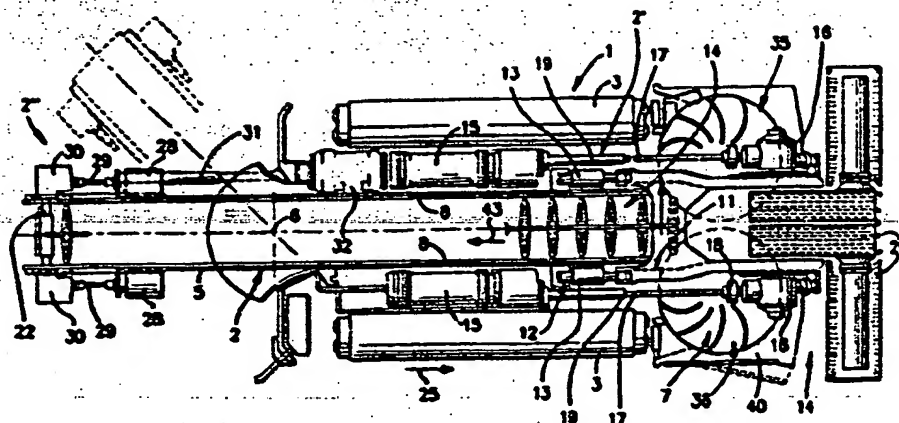


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(54) Title: MINING ULTRA THIN COAL SEAMS



(57) Abstract

A continuous mining machine (4) is provided for mining ultra thin coal seams (54), e.g. seams having a thickness of about 60 centimeters or less. A chassis (25) supported by crawler tracks (53) has a substantially horizontal axis powered cutter head (14) mounted to its front and a conveyor (4) extending from a gathering head (7) toward the rear of the chassis. The conveyor includes a conveyor chain (9) driven by at least one motor (28) near the rear of the chassis for driving a sprocket. The gathering head includes a pair of counter-rotating discs (35, 36) with upstanding vanes (37) and a deck (40) having a maximum angle of about 10° with respect to the dimension of elongation (25) of the chassis. A small diameter idler sprocket (23) for the conveyor chain is mounted beneath the deck, and a small diameter drive sprocket (21) is provided for the cutting chain of the cutting head. The mining machine is controlled to keep it within a coal seam to be cut by using a first color video camera (60) scanning the ceiling (51) of the bore cut by the miner, and a second color video camera (61) scanning the floor (41). The mining machine may be used in a method of mining in which, after formation of a main bore (42) of about 90-180 meters long, during withdrawal the machine forms a number of angled bores (60) each roughly as long as the length of the machine.

WHAT IS CLAIMED IS:

1 1. A continuous mining machine (1) comprising: a chassis (2)
2 supported by crawler tracks (3), and having a front (2') and a rear (2'')
3 and elongated in a first dimension (25) between said front and said
4 rear; a powered substantially horizontal axis cutter head (14) mounted
5 to said front of said chassis; a conveyor (4) mounted to said chassis
6 and including an endless conveyor chain (9); said chain connected to
7 first (21) and second (23) sprockets, said first sprocket mounted for
8 rotation about a first shaft (22) adjacent said rear of said chassis, and
9 said second sprocket mounted for rotation about a second shaft (24)
10 adjacent said front of said chassis but between said first sprocket and
11 said cutter head; said first and second shafts rotatable about axes
12 generally perpendicular to said first dimension; and characterized by:
13 at least one motor (28) mounted adjacent said rear of said
14 chassis for driving said first shaft to thereby drive said first sprocket
15 and said conveyor.

1 2. A mining machine as recited in claim 1 further characterized
2 in that said second shaft comprises an idler shaft.

1 3. A mining machine as recited in claim 1 or 2 further
2 characterized by a gathering head (7) mounted adjacent said front of
3 said chassis and below said cutter head and at least partly to the rear
4 of said cutter head, for gathering material cut by said cutter head and
5 moving the cut material to said conveyor.

1 4. A mining machine as recited in claim 3 further characterized
2 in that said gathering head comprises a pair of counter-rotating discs

3 (35, 36) with upstanding vanes (37), and an angled deck (40)
4 substantially coplanar with said discs, and wherein said second shaft
5 has first and second transmission elements (45) connected thereto,
6 said first and second transmission elements operatively connected to
7 said discs for effecting counter-rotation driving thereof.

1 5. A mining machine as recited in claim 4 further characterized
2 in that said angled deck during normal operation makes a maximum
3 angle of about 10° with respect to said dimension of elongation of said
4 chassis.

1 6. A mining machine as recited in any preceding claim further
2 characterized in that wherein said chassis has a maximum height of
3 about 50 cm and said cutter head has a maximum effective diameter
4 of about 56 cm.

1 7. A mining machine as recited in claim 4 or 5 or 6 further
2 characterized in that said second sprocket has a maximum diameter of
3 about 20 cm and is mounted beneath said deck, and said cutting head
4 includes a cutting chain drive sprocket (75) with a maximum diameter
5 of about 18 cm.

1 8. A mining machine as recited in claim 7 further characterized
2 by a plurality of cross bars (10) connected to said chain for moving
3 conveyed material from said gathering heads to said rear of said
4 chassis; and further characterized in that said second sprocket
5 comprises a four-tooth sprocket, and said cutting chain-drive sprocket
6 of said cutting head comprises a five tooth sprocket.

1 9. A mining machine as recited in any preceding claim further
2 characterized by a first color video camera (60) mounted on said
3 chassis or said cutter head in a position to scan material being cut
4 above said cutter head and utilizable to determine the color thereof,
5 said first video camera connected to a monitor (59) to the rear of said
6 chassis.

1 10. A mining machine as recited in claim 9 wherein said mining
2 machine forms a floor during operation; and further characterized by a
3 second color video camera (61) mounted to said chassis or said cutter
4 head in a position to scan the floor cut by said mining machine and
5 utilizable to determine the color thereof, said second video camera
6 connected to said monitor.

1 11. A mining machine as recited in claim 1 further
2 characterized by a gathering head mounted adjacent said front of said
3 chassis and below said cutter head and at least partly to the rear of
4 said cutter head, for gathering material cut by said cutter head and
5 moving the cut material to said conveyor, said gathering head
6 comprising a pair of counter-rotating discs with upstanding vanes, and
7 an angled deck substantially coplanar with said discs;
8 wherein said second shaft has first and second transmission
9 elements connected thereto, said first and second transmission
10 elements operatively connected to said discs for effecting counter-
11 rotation driving thereof,

12 wherein said angled deck during normal operation makes a
13 maximum angle of about 10° with respect to said dimension of
14 elongation of said chassis; and

15 wherein said second sprocket has a maximum diameter of
16 about eight inches and is mounted beneath said deck.

1 12. A mining machine as recited in any preceding claim further
2 characterized in that said at least one motor comprises two motors,
3 one on either side of said chassis, and wherein said motors are
4 operatively connected to said first shaft through splined telescoping
5 transmission shafts (29), and gear boxes (30).

1 13. A method of mining coal in seams (54) having an average
2 thickness of less than 1.2 meters using a continuous mining machine
3 (1) having a chassis (2) mounted by crawler tracks (3), a cutter head
4 (14) at the front of the chassis, an articulated rear end (2"), a first
5 conveyor (4) for conveying cut coal from the cutter head to the rear of
6 the chassis, and a second conveyor (33) operatively associated with
7 the rear end to convey coal from a bore (42) toward a mouth (58) of
8 the bore, the continuous miner having a predetermined length from the
9 cutter head to the rear of the chassis, said method characterized by
10 the steps of:

11 (a) forming a main mine bore (42), having first and second side
12 walls, a roof, and a floor, by powering the crawler tracks and cutter
13 head to move the continuous miner through the mine mouth into the
14 coal seam a depth of more than 45 meters in a first direction, while
15 cutting coal and conveying the coal toward the mouth using the first
16 and second conveyors;

17 (b) after the practice of step (a), retracting the continuous miner
18 a distance of greater than about ten feet, and

19 (c) after the practice of step (b), forming a secondary mine bore
20 (69) by powering the crawler tracks and the cutter head to move the
21 continuous miner into the coal seam through the main mine bore side
22 walls at an angle of greater than about 20° and less than about 80° to
23 the first direction for a distance roughly equal to the predetermined
24 length of the miner, while cutting coal and conveying cut coal toward
25 the mouth using the first and second conveyors.

1 14. A method as recited in claim 13 characterized by the further
2 step (d) of repeating steps (b) and (c) at least once after the practice
3 thereof.

1 15. A method as recited in claim 14 further characterized in that
2 step (c) is practiced by moving the miner into contact with the first side
3 wall of the main bore, and step (d) is practiced first after step (c) by
4 moving the miner into contact with the second side wall of the main
5 bore.

1 16. A method as recited in claim 14 or 15 further characterized
2 in that step (d) is practiced a plurality of times, alternating between
3 moving the miner into contact with the first side wall of the main bore
4 and the second side wall of the main bore.

1 17. A method as recited in claim 14, 15 or 16 further
2 characterized in that the coal seam has an average thickness of about
3 one meter or less, and steps (c) and (d) are practiced to penetrate the

4 side walls a distance of between about 6-13 meters in forming each
5 secondary bore.

1 18. A method as recited in claim 13, 14, 15, 16, or 17 further
2 characterized in that the coal seam has an average thickness of about
3 6 meters or less.

1 19. A method as recited in any of claims 13 - 18 further
2 characterized in that during the practice of step (a) the miner is
3 remotely controlled by a human operator, and wherein the miner has
4 at least a first color video camera (50) mounted thereon; and
5 characterized by the further step of scanning the roof (51) of the bore
6 adjacent the cutter head to determine the color thereof, and then the
7 human operator adjusting, if necessary, the position of the cutter head
8 and the vertical orientation of the miner in response to that scanning.

1 20. A method as recited in claim 19 further characterized in that
2 wherein the miner has a second color video camera (61) mounted
3 thereon; and characterized by the further step of scanning the floor
4 (41) of the bore with the second video camera to determine the color
5 thereof, and then the human operator adjusting, if necessary, the
6 position of the cutter head and the vertical orientation of the miner in
7 response to that scanning.

1 21. A method as recited in any of claims 13 - 20 further
2 characterized in that step (a) is practiced to penetrate the coal seam a
3 distance of between about 90-150 meters.

1 22. A method as recited in any of claims 14 - 16 and 18 - 21
2 further characterized in that steps (c) and (d) are practiced to
3 penetrate the coal seam a distance of between about 6-13 meters in
4 forming each secondary bore.

1 23. A continuous mining machine (1) comprising: a chassis (2)
2 supported by crawler tracks (3), and having a front (2') and a rear (2'')
3 and elongated in a first dimension (25) between said front and said
4 rear, a substantially horizontal axis powered cutter head (14) mounted
5 to said front of said chassis; a conveyor (4) mounted to said chassis
6 and including an endless conveyor chain (9); said chain connected to
7 first (21) and second (23) sprockets, said first sprocket mounted for
8 rotation about a first shaft (22) adjacent said rear of said chassis, and
9 said second sprocket mounted for rotation about a second shaft (24)
10 adjacent said front of said chassis but between said first sprocket and
11 said cutter head; said first and second shafts rotatable about axes
12 generally perpendicular to said first dimension; characterized by:
13 at least one motor (28) for driving one of said first and second
14 shafts to thereby drive one of said sprockets and said conveyor;
15 a gathering head (27) mounted adjacent said front of said
16 chassis and below said cutter head and at least partly to the rear of
17 said cutter head, for gathering material cut by said cutter head and
18 moving the cut material to said conveyor, said gathering head
19 comprises a pair of counter-rotating discs (35, 36) with upstanding
20 vanes (37), and an angled deck (40) substantially coplanar with said
21 disc;
22 said second shaft having first and second transmission
23 elements (45) connected thereto, said first and second transmission

24 elements operatively connected to said discs for effecting counter-
25 rotation driving thereof.

26 said angled deck during normal operation making a maximum
27 angle of about 10° with respect to said dimension of elongation of said
28 chassis; and

29 said chassis having a maximum height of about 50 cm; and said
30 cutter head having a maximum diameter of about 56 cm.

1 24. A mining machine as recited in claim 23 further
2 characterized in that said second sprocket has a maximum diameter of
3 about 20 cm and is mounted beneath said deck.

1 25. A mining machine as recited in claim 23 or 24 further
2 characterized in that said cutting head includes a cutting chain drive
3 sprocket (75) with a maximum diameter of about 18 cm.

1 26. A mining machine as recited in claim 25 further
2 characterized in that said second sprocket comprises a four tooth
3 sprocket, and said cutting chain drive sprocket of said cutting head
4 comprises a five tooth sprocket.

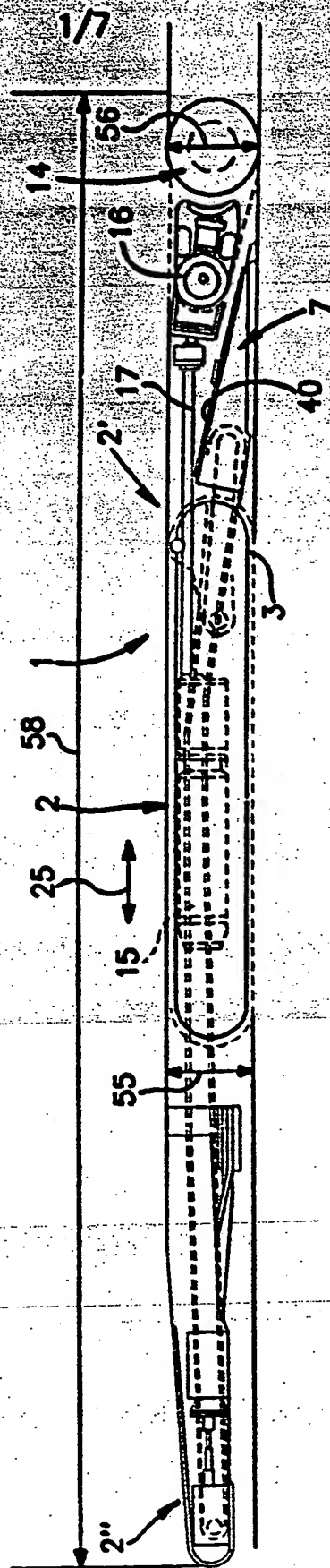


FIG. 1

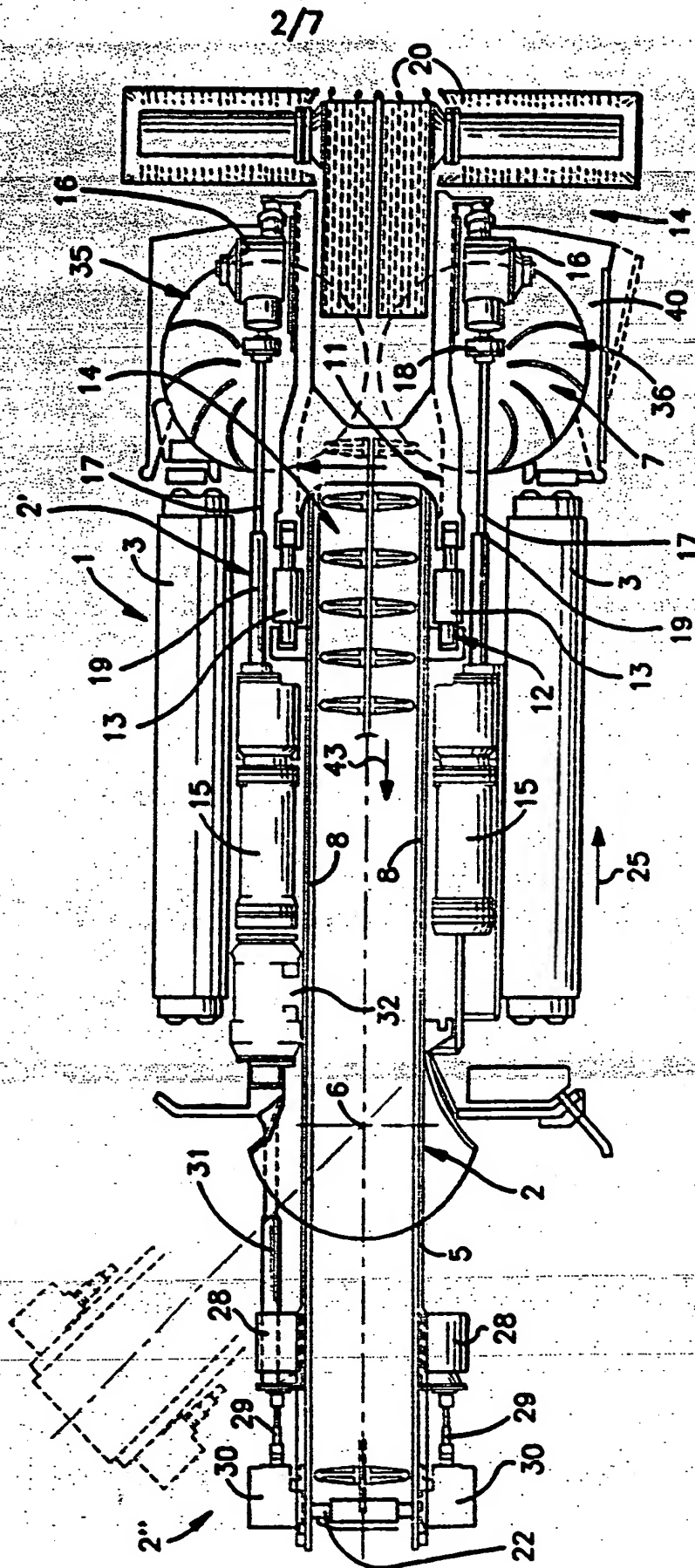


FIG. 2

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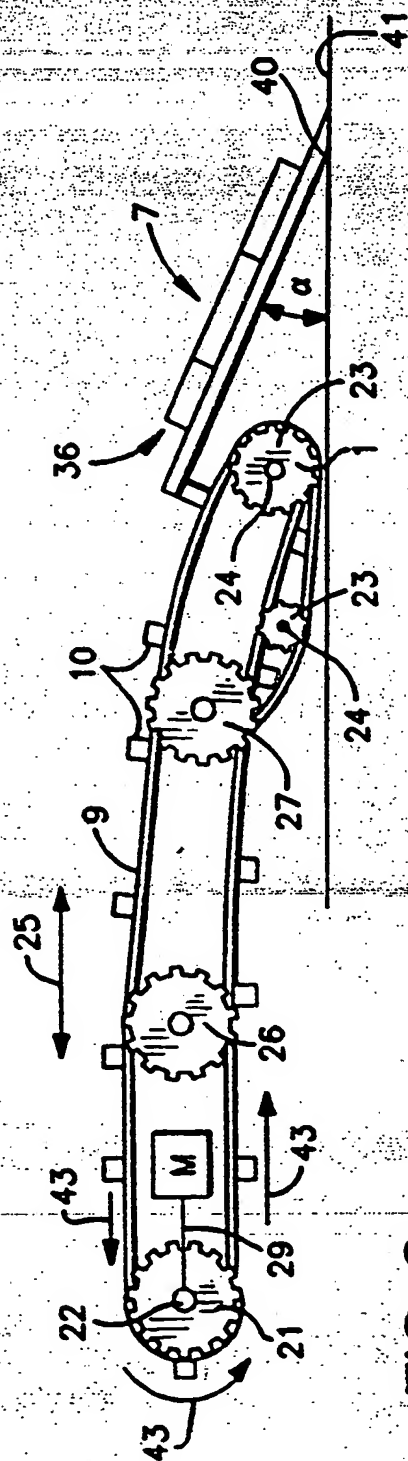


FIG. 3

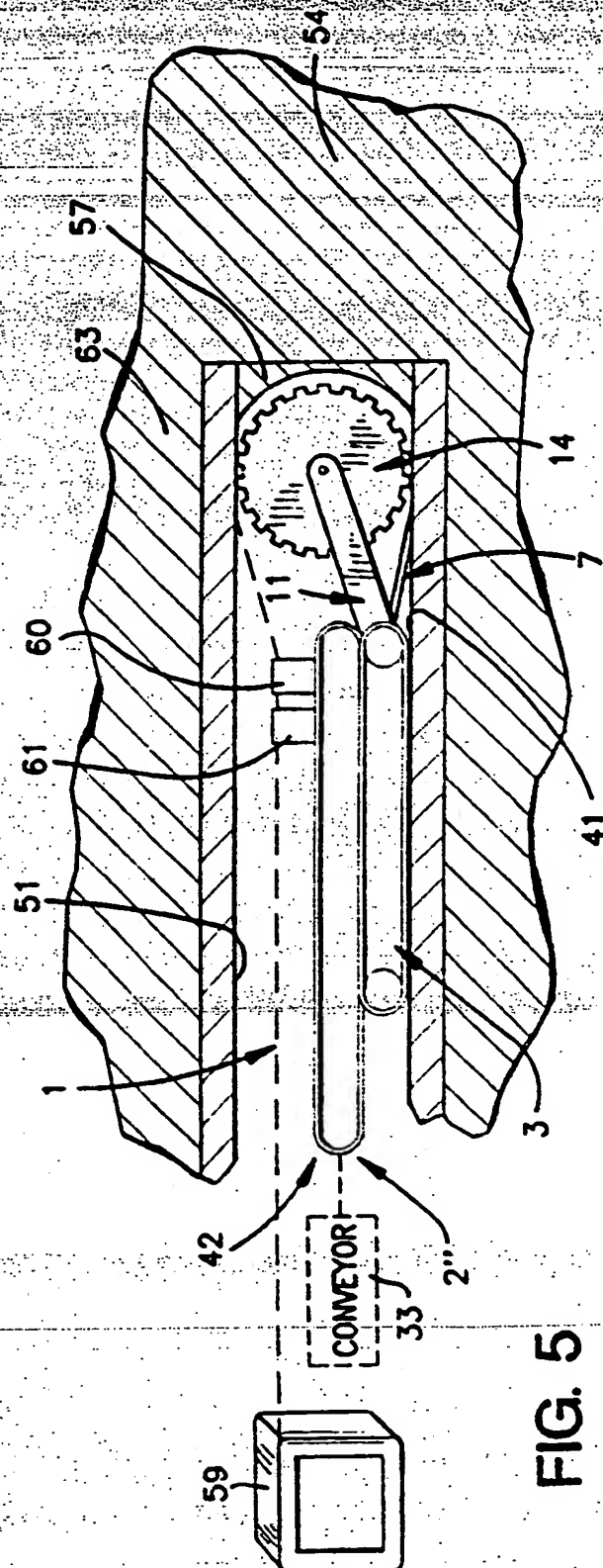


FIG. 5